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Written English into spoken: A functional discourse analysis of American, Indian, and Chinese TA presentations

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Abstract
International teaching assistants (ITAs) often receive specialized training because their spoken English is not easily comprehensible. Lack of comprehensibility may be influenced by grammatical issues (Tyler, 1994), incorrect or inadequate discourse structure (Tyler, 1992; Williams, 1992), or aspects of their pronunciation, such as unclear sentence focus (Hahn, 2004) or intonation (Pickering, 2001; Wennerstrom, 1998). Problems with comprehensibility may be compounded by ITAs having learned English through formal, written models. However, we do not know how ITAs change written text into an oral lecture, nor how their strategies differ from those of native teaching assistants (NTAs) doing the same task. This paper reports results of such a study. We video-recorded three different groups of engineering TAs (American, Chinese, and Indian) presenting information from a textbook passage. Each TA was asked to read the same passage taken from a first-year college physics textbook, and then to teach the content in spoken English. Presentations were transcribed and analyzed using a Systemic Functional Linguistics approach (Halliday, 1994; Halliday & Matthiessen, 2004; Mohan, 2007). Changes made by each group of TAs from the written to the spoken language were compared, and the strategies used by each group to mark their changes from written into spoken language were examined. The results provide a baseline measure of strategies for turning written into spoken texts used by the TAs in our study. Implications for TA training are discussed.

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Written English into Spoken: A Functional Discourse Analysis of American, Indian, and Chinese TA Presentations

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International teaching assistants (ITAs) often receive specialized training because their spoken English is not easily comprehensible. Lack of comprehensibility may be influenced by grammatical issues (Tyler, 1994), incorrect or inadequate discourse structure (Tyler, 1992; Williams, 1992), or aspects of their pronunciation, such as unclear sentence focus (Hahn, 2004) or intonation (Pickering, 2001; Wennerstrom, 1998). Problems with comprehensibility may be compounded by ITAs having learned English through formal, written models. However, we do not know how ITAs change written text into an oral lecture, nor how their strategies differ from those of native teaching assistants (NTAs) doing the same task. This paper reports results of such a study. We video-recorded three different groups of engineering TAs (American, Chinese, and Indian) presenting information from a textbook passage. Each TA was asked to read the same passage taken from a first-year college physics textbook, and then to teach the content in spoken English. Presentations were transcribed and analyzed using a Systemic Functional Linguistics approach (Halliday, 1994; Halliday & Matthiessen, 2004; Mohan, 2007). Changes made by each group of TAs from the written to the spoken language were compared, and the strategies used by each group to mark their changes from written into spoken language were examined. The results provide

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a baseline measure of strategies for turning written into spoken texts used by the TAs in our study. Implications for TA training are discussed.

No matter the teaching context or teacher, it is necessary to present and explain content related to the class. This may take the form of extended lectures, or it may involve shorter clarifications. Previous research has shown systematic differences between the way material is presented by native English speaking teaching assistants (NTAs) and by those who speak English as an additional language, or International Teaching Assistants, also known as ITAs (Tyler & Bro, 1992; Williams, 1992). Some of these differences are linguistic in nature, while some are cultural (Jenkins, 2000; Myles & Cheng, 2003). According to Hoejke and Williams (1992), ITAs may show differences from NTAs in their ability to connect meaning across sentences (discourse competence), their grammar and pronunciation (grammatical competence), their ability to use appropriate language in the classroom (sociolinguistic competence), and the ways they negotiate meaning when a breakdown in communication occurs (strategic competence).

Most research comparing ITAs and NTAs has analyzed performance at the level of grammatical and discourse competence (e.g., Kang, 2010; Pickering, 2004), with ITAs' oral communication abilities often being evaluated negatively (Fitch & Morgan, 2003). It also appears that different cultural views of teaching, classroom roles, and life outside the classroom may be critical factors in how ITAs are perceived (Gorsuch, 2003; Myles & Cheng, 2003). Even the belief that their interlocutor cannot speak English well can lead listeners to believe that communication will be difficult or impossible (Rubin, 1998). It is because of such situations that undergraduates may have difficulty understanding their ITAs (Rubin, 1992) or may be unwilling to try communicating because they believe they cannot understand them (Damron, 2000).

Dividing TAs into two groups according to native language (English speaking natives versus others) is an oversimplification of the diversity of Englishes among TAs in U.S. universities. This study compares the spoken performance in constructing appropriate discourse by three groups of TAs, from the United States, India, and China. These three groups were chosen because they represent three different cultural and acquisitional contexts of

learning English. There are those who learn English as a native language (the inner circle); those who learn English in India, where English has an official role (the outer circle); and those who learn English in China, where English has no official role (the expanding circle; Kachru, 1992). These three groups of TAs were also chosen because they represent the largest groups of teaching assistants in graduate programs at the university where this study took place. Fischer (2009) reports that China and India are also the largest contributors of students to U.S. universities, accounting for nearly 45 percent of total graduate students. Open Doors (2010) includes undergraduate student enrollment in this estimation and reports that the same two countries make up 33.7 percent of total international student enrollment in the U.S.

We will review how ITA spoken discourse differs from that of NTAs in organization, lexico-grammatical features, and prosody. We will then examine how written discourse is related to its spoken presentation and describe our analytical framework.

Discourse Competence: Constructing Meaning Beyond the Sentence

Even when ITA discourse is grammatically accurate and adequately pronounced, evidence shows that ITA presentations can be less comprehensible than presentations given by NTAs. Tyler (1992) asked raters to listen to two presentations, one given by an ITA and one by an NTA. Both presentations were transcribed and read aloud by a native speaker of English (NS) in order to remove pronunciation as a factor. The discourse created by the ITA was rated as being less effective and less easy to follow than that given by the NTA. Tyler argued that this judgment was related to the way information was structured in the presentation, especially in the ITAs' use of unexpected, nonparallel discourse markers (e.g., *the first one* followed by *and then* and *after that*), their not establishing clear synonyms or clearly linking pronominal forms to the original noun phrases, and their over-use of coordination and under-use of subordination, leading to unclear links between different levels of informational importance.

Another finding indicates that the ways ITAs link relationships between information can be important in making their discourse more comprehensible. Williams (1992) found that

when discourse moves were explicitly marked, ITA presentations were rated as being more comprehensible. Nonetheless, Hoejke and Williams (1992) suggested that ITAs did not seem aware of the role of spoken discourse markers in increasing comprehensibility, saying "ITAs who rely on prepared notes in teaching often present information orally in a style more appropriate for written texts" (p. 256). Tyler and Bro (1992) found that ITAs overused simple additive connectors that were ambiguous in the connections between ideas they suggested to listeners. In a related finding, Chaudron and Richards (1985) examined the use of discourse markers in lectures and found that those markers which indicate overall text organization (macro markers) helped students follow the lecture better than markers indicating links between sentences or fillers (micro markers).

Grammatical Competence: The Importance of Lexico-grammatical Decisions

At the level of grammatical competence, lexico-grammatical features may hamper ITAs' ability to communicate information clearly. Research comparing the teaching performance of ITAs and NTAs has shown systematic differences in the lexico-grammatical features of both. Tyler, Jefferies, and Davies (1988) found that NTAs often used topicalization to focus listener attention on information to be foregrounded and backgrounded. ITAs did not.

Chiang (2011) examined ITA interactions with NS undergraduates in office hours, finding that ITAs' inappropriate use of pauses confused the undergraduates, leading them to believe that the ITAs did not understand their questions. Further, the ITAs were often found to give incomplete answers or to give answers that did not answer the students' questions. Liao (2009) examined Chinese ITAs' use of common English spoken discourse markers in interactions with an interviewer and found that the ITAs overused some (especially *yeah*) and underused others (*well, I mean*). Overall, their markers were more restricted in range than for NTAs and included innovations that were not likely to be understood easily by NS interlocutors.

Prosody: Communicating Informational Importance

Pronunciation errors, especially those involving prosody, have been implicated in the comprehensibility of ITA speech (Hinofotis & Bailey, 1981). Anderson-Hsieh and Venkatagiri (1994) examined Chinese speakers' syllable duration, pausing, and articulation rates in English and found that these prosodic features appeared to be connected to spoken language proficiency. The Chinese ITAs who scored high on a speaking performance test had similar syllable durations and pause behavior compared to a control group of NSs. The lower scoring Chinese ITAs, however, placed pauses in inappropriate places, spoke more slowly, and had a smaller difference in ratios between focused and unstressed syllables than the other groups.

There is also evidence that ITAs and other non-NSs may not be aware that English speakers make use of prosody to communicate meaning. Tyler, Jefferies, and Davies (1988) found that ITAs showed lack of awareness of the function of focus ("nuclear stress") and intonation before pauses in creating coherence. They also did not successfully signal parenthetical information. In another study, Pennington and Ellis (2000) found that Cantonese speakers of English did not identify meaning differences based on prosody. Even after explicit instruction, learners showed improvement in hearing only one of four prosodic features.

Accented speech may be understood more or less successfully. Hardman (2010) examined the intelligibility of Chinese-accented English (presented with noise) to varied groups of listeners. There was some evidence of an interlanguage speech intelligibility benefit (Bent & Bradlow, 2003) for Chinese listeners, but for listeners of other language backgrounds, Chinese accented speech was less intelligible than American English. It can be argued that in general, U.S. students do not understand unfamiliar accents well. Fitch and Morgan (2003), studying student narratives describing their time in ITAs' classes, found that a common view of ITAs was that they "couldn't speak a lick of English" (p. 302), a characterization that included pronunciation and non-pronunciation features.

The function of prosody in signaling discourse structure. Prosody is particularly important in English for marking the rela-

tive importance of information in a spoken text, thus acting as an important signal of cohesion (Wennerstrom, 1998). This is done through a variety of features, including syllable length, pitch extrusion, and pitch suppression. The most important of these prosodic features is known as focus, also called primary phrase stress (Dickerson, 1989), nuclear stress (Ladd, 1980), pitch accent (Pierrehumbert, 1980) and tonic (Halliday, 1967). Focus refers to the way Inner Circle speakers of English use a combination of features to call attention to words or syllables that are particularly salient in the discourse. Focus is relative, and salience may be marked both through attention to informationally important syllables and suppression of pitch, especially for given information (Baumann & Hadelich, 2003)

The first pattern in which focus is used in discourse is to call attention to contrasts (Bolinger, 1972; Umbach, 2001). Contrast may be seen as calling attention to narrow focus rather than broad focus (Welby, 2003). In our data, focus usually explicitly marked contrasts between *forms of energy* (a key feature of the text we used). The second focus pattern relates to whether information is given or new. New information is likely to be marked by focus, thus foregrounding it in the discourse. Given information will have lack of focus, thus prosodically backgrounding it in the discourse. Given information may be more or less backgrounded; that is, it may be marked as given or accessible (Baumann & Hadelich, 2003). Although focus also makes use of lexical and syntactic markers (Ward & Birner, 2004), speakers in English make use of prosody to signal which information "the speaker has decided to present as not being already available to the hearer" (Halliday, 1970, 40). Prosodically focused syllables were found to have twice the duration and significantly higher pitch than non-focused, stressed syllables in one study of authentic teacher discourse (Riesco-Bernier & Romero-Trillo, 2008).

Focus is important because it allows listeners to understand spoken discourse more effectively. Hahn (2004) found that NS undergraduate students' recall of key points in a short lecture was significantly affected by whether focus was placed on the correct word, the wrong word, or whether focus did not exist. Pickering (2001), in another study of new and given information, found that Korean TAs used a different pattern of rising and fall-

ing intonation in discourse than did native English speaking TAs. Using Brazil's (1997) theory of discourse intonation, Pickering concluded that Korean TAs did not call attention to either new or given information in a way that promoted comprehension.

Written into Spoken Language

In most teaching contexts, instructors are likely to draw on course textbooks and other materials to help frame their explanations. Shulman (1987) describes the centrality of textbooks and other materials in this way:

> …most teaching is initiated by some form of "text:" a textbook, a syllabus or an actual piece of material that the teacher or student wishes to have understood. The text may be a vehicle for the accomplishment of other educational purposes, but some sort of teaching material is almost always involved. (p. 14)

Despite the centrality of textbooks and other materials, we know very little about how teachers turn written text into spoken presentations of course material. In one review, Moulton (1997) examined the use of textbooks both in African and U.S. contexts. She found that textbooks loomed large in educational reform initiatives but that the ways published materials were used by teachers were only indirectly related to teaching practices.

It may be that teachers who are teaching a class for the first time or presenting new material, or those under time pressure, will rely on the information and organization found in published material. This reliance may be even greater for non-native speakers of English, who, even when they understand course content, may have a more limited ability to summarize, paraphrase, and connect material clearly in a spoken register (Tyler et al, 1988). Hoejke and Williams (1992) noted that "ITAs who rely on prepared notes in teaching often present information orally in a style more appropriate for written texts" (p. 256). In another study relating written and spoken discourse, Tyler (1994) took a discourse analytic approach to two talks, one given by a Korean ITA and one given by an NTA, both in their first semester of teaching. Both talks used the same set of 33 slides prepared by the TAs' Botany professor. The professor helped them prepare by going through the information and explaining which points were most

important. Both TAs then planned and taught the material. Tyler found that the native TA used more subordination, leading to a more hierarchical construction of discourse in which the relative importance of information was more clearly marked.

Like Tyler (1994), this study examined the strategies used by TAs to turn a written text into a spoken presentation. Using a written prompt on a single topic, we examined how TAs from three different language backgrounds transformed a paragraph from a textbook into a spoken lesson. Our goal was to identify the similarities and differences in how their spoken discourse was constructed, the lexical and grammatical choices they made to construct the discourse, and the ways in which they used the prosodic resources of spoken language to present. An awareness of the similarities and differences among these three groups may allow us to determine more effective targets for TA and ITA development.

The Analytical Framework

For our analysis, we followed Systemic Functional Linguistics, or SFL (Halliday, 1994; Halliday & Matthiessen, 2004), which views language as a vast system from which language users can choose. SFL offers the tools to examine language in four dimensions of meaning: metafunction (three broad functions of language), stratification (three levels of language), axis (complementary perspectives on language), and rank (layers of structure within each strata)(Rose, 2006). Our discussion here focuses on metafunction.

A particular text is the result of the choices speakers make from their linguistic systems. From a metafunction perspective, a text can be described in terms of three types of meaning, or functions: *ideational, interpersonal* and *textual*. *Ideational meaning* refers to the content of the text and draws from the linguistic resources we have for representing our experiences of the world. *Interpersonal meaning* is concerned with the social roles and relationships that are constructed in the texts. *Textual meaning* refers to the medium and role of language and relates to the resources we have for constructing coherent and connected texts. Our analysis targeted key areas of the *ideational* and *textual* functions to illustrate how the three groups of TAs constructed science

knowledge structures, and how their choices affected the comprehensibility of that knowledge in its oral form.

Ideational Meaning

To compare the participants' constructions of ideational meaning, we adopted the concept of "knowledge structures" (Mohan, 1986; 2007). We explored the content knowledge that was constructed in the initial prompt as well as how it was reconstructed by each speaker, thus revealing similarities and differences amongst the various speakers' short lectures. Mohan, whose work is strongly rooted in SFL, describes six knowledge structures (KSs) as comprising a "Knowledge Framework" (KF), a heuristic that describes in linguistic terms the types of knowledge evident in human activities. Each of the three pairs of KSs, classification/description, principles/sequence, and evaluation/choice, is characterized by linguistic features that define the knowledge being constructed (see Figure 1 below). These parallel what Halliday refers to as the three realms of experience that are part of science discourse: *being* (classification/description), *action* (principles/sequence), and *signification* (evaluation/choice), with each realm correlating roughly with a main class of verbs (Halliday & Martin, 1993). Processes of *being* and *having* serve to mark the identification, description, and classification of things, qualities, or processes. Processes of *doing* relate to *action* in constructing events and activity sequences, including cause-effect and means-end relationships. Processes that *signify* human consciousness, including mental and verbal processes, correlate with verbs of perceiving, thinking, feeling, saying, evaluating, and choosing. Modern science discourse (Halliday & Martin, 1993) uses a high number of *being* and *action* processes. As well as noting the general knowledge structure patterns as processes, we examined and compared the types of nominal groups (i.e., noun phrases of all types) used by the TAs.

Textual Meaning

In analyzing the textual meaning of participants' talks, the dimension of *stratification* allows us to examine the connections amongst sounds (phonology), grammar (wording), and discourse (meaning). With respect to the textual, the meanings are, as Mar-

tin and White (2005) described, "concerned with various aspects of discourse organization, including the question of how people, places, and things are introduced in the text and kept track of... how events or states of affairs are linked to one another… how

C/D **Classification/Description**	**P/S** **Principles/Sequence**	**E/Ch** **Evaluation/Choice**
<u>Classification</u> Types: classification, definition Language features: • General reference • Relational processes (e.g., *be, have*) • Additive conjunction (e.g., *and*) • Taxonomic, part/whole lexis (e.g., *types, kinds*; verbs: *classify, sort, organize*) • Passives (e.g., *are classified, are grouped*)	<u>Principles</u> Types: explanation, prediction, conclusion, hypothesis formation, causes, effects, rules, means, ends Language features: • General reference • Material processes (action verbs) • Consequential conjunction, adverbs, and adverbials e.g., *since, due to, consequently, thus, because, if*-clauses) • Cause-effect lexis (e.g., nouns: *cause, effect, result*; verbs: *cause, produce, bring about*)	<u>Evaluation</u> Types: evaluation, judgment, criticism, justification Language features: • General reference • Mental processes (e.g., *believe, think, value, consider, rank, judge*) • Comparative conjunction (e.g., *likewise, however, while*) • Evaluative lexis (e.g., nouns: *best, worst*; adjectives: *good, bad, right, wrong, boring, acceptable*; verbs: *rank, approve, value, like*)
<u>Description</u> Types: description, comparison/contrast, quantification, spatial order Language features: • General or specific reference • Relational processes, existential processes (e.g., *there is/are*) • Additive conjunction (e.g., *and*) • Attributive lexis (e.g., adjectives of color and size) • Language of comparison and contrast (e.g., *the same as, similar to, like, different from*)	<u>Sequence</u> Types: sequence, cycles, chronological order, processes, narration, reporting, instructing Language features: • Specific reference • Material processes (action verbs) • Temporal conjunction, adverbs, and adverbials (e.g., *after, since, as initially, firstly, finally, when*-clauses, *as*-clauses) • Sequential lexis (e.g., nouns: *beginning, end*; verbs: *start, conclude, continue, summarize)*	<u>Choice</u> Types: personal opinion, refutation Language features: • Specific reference • Mental processes • Alternative conjunction (e.g., *or*) • Oppositional choice lexis (e.g., nouns: *choice, option, which*+noun; verbs: *choose, opt, select, prefer*)

Figure 1. The Knowledge Framework (adapted from Mohan, 1986).

participants are related as part to whole and sub-class to class" (p. 9). While Eggins (1994) stated that an adequate description of language requires attention to all three strata (phonology, wording, and meaning), in the current study we looked at the ways the participants used prosody to build coherence and cohesion in their spoken texts.

Although Knowledge Structure Analysis has been used to analyze the discourse produced by ITAs during Oral Proficiency Interviews (Mohan, 1998), formative assessment tasks in ESL classrooms (Leung & Mohan, 2004), and science teaching and learning sequences (Mohan & Slater, 2005; 2006; Slater & Mohan, 2010), KSA has not been used to examine how teaching assistants (or teachers, for that matter) create a lecture from a text prompt. Yet given that we wish to explore and compare the meanings that these groups of TAs are constructing for their perceived audience, we feel that KSA will uncover several differences that we may not be able to detect using other theory-based analytical frameworks.

Research Questions

Our goal was to see how three groups of TAs took a written text with a clearly developed chain of knowledge structures and turned it into a spoken text. Specifically, we asked:

1. How do the TAs use the knowledge structures of the written prompt in constructing their oral text, both the types of knowledge structures and the functions the structures serve?
2. What kinds of lexico-grammatical strategies do the TAs use to convey the information in their spoken texts?
3. How does the prosody that the TAs use affect and influence the presentation of the information in the spoken texts?

Method

Participants

Participants (see Appendix A for their identifier codes) were all male graduate students in electrical and computer engineering at a central U.S. university. All were paid for their participation. All were teaching assistants, and while they

varied in their teaching experience from one to four or more semesters, most had taught for two semesters. Their duties included maintaining office hours and assignment grading as well as leading recitations. We recorded a total of 14 TAs with four of them native American English TAs, four Indian ITAs, and six Chinese ITAs.

Materials

Participants were given a paragraph from a basic physics textbook on the topic of "energy" and asked to expand it into a short lecture. We chose this topic because it was likely to be accessible to undergraduates (the target audience) taking a basic class in engineering or physics (see Figure 2).

This short text was broken into key patterns of knowledge structures (KSs) to address research question number one. To do this, we marked the key classification/description features in **bold** and the key principles/sequence features in *italics* (Table 1).

Table 1 offers a simplified analysis of the written prompt. As can be seen, the text defines energy in general, offers a classification of energy types, and elaborates on two of these types using causal language (principles/sequence) before restating the key message(s) of the text. The majority of the clauses either function to classify/describe or to show action of some kind (causal/means-end/sequential). Only two of the classified list of energy

> Energy is a peculiar quantity in that it has many seemingly different forms. You have no doubt heard of many of these: kinetic energy, potential energy, heat energy, chemical energy, nuclear energy, and electric energy. Each form of energy contains within itself the ability to do work. The work you and I do without the aid of machines is possible because we make use of the chemical energy in the food we eat. Electric motors can do work because of the electric energy supplied to them. No matter what form of work is being done, an energy source of some sort is needed to accomplish the work. It is for this reason that energy is so important to us. Without it, the capability of doing work would cease to exist.

Figure 2. Textbook prompt used to teach (Bueche, 1981, p. 53)

types are elaborated on (chemical energy and electrical energy), both with cause/effect "because" clauses. The text does not use KSs of choice or evaluation beyond the interpersonal "you have no doubt heard of;" In other words, meanings are not explicitly constructed using resources characteristic of choice or evaluation. This text thus mirrors the kinds of knowledge structures that characterize scientific discourse, in which technical taxonomies are constructed and relations among items are provided (Halliday & Martin, 1993).

Procedure

Participants were given five minutes to read the prompt silently and to look up unfamiliar vocabulary in a dictionary. They were then recorded reading the text aloud. Finally, they were

Table 1. Knowledge Structure Analysis of the Text Prompt

	Wording	***Knowledge structures***	***Function***
1.	Energy **is** a peculiar quantity.	classification/description (C/D)	Defines
	in that it **has** many seemingly different forms.	classification/description (C/D)	Introduces a taxonomy
2.	(You have no doubt heard of) **many of these**: kinetic energy, potential energy, heat energy, chemical energy, nuclear energy, and electrical energy.	classification/description (C/D)	Offers a list of types in technical terms
3.	Each form of energy **contains** within itself the ability to do work.	classification (C/D)	Offers a common characteristic of all members of the classification
4.	The work you and I *do*… **is** possible *because* we make use of…	principles/sequence (P/S)	Offers a causal relation for one type of energy (chemical)
5.	Electric motors can *do* work *because* of the electric energy *supplied* to them.	principles/sequence (P/S)	Offers a causal relation for one type of energy (electrical)
6.	No matter what form of work *is being done*, an energy source… *is needed to accomplish* the work.	principles/sequence (P/S)	Restates 4 in causal (means/end) terms
7.	It **is** for this *reason* that energy **is** so important to us.	principles/sequence (P/S)	Restates 4 in causal (cause/effect) terms
8.	Without it, the capability of *doing* work *would cease to exist*.	principles/sequence (P/S)	Restates 4 in causal (means/end) terms

given 20 minutes to prepare a four- to six-minute presentation of the information. They were told to imagine that their audience was a group of freshmen in a beginning-level science class, and to teach all of the information in the text, explaining it as clearly as possible. Participants were also told they could illustrate the information with additional information, details, and examples. They were given paper to make notes, but were not allowed to use the text prompt while teaching. Their notes were collected at the end of their presentations. The subjects were video-recorded teaching their presentations using only chalk and a blackboard. The only other person in the room was one of the researchers.

Transcription conventions. All presentations were orthographically transcribed. Through repeated listening by two of the researchers, each presentation was divided into phrases, or tone units. Prosodic features such as intonation and focus were defined within the domain of the tone unit (Cruttenden, 1997). Tone units in English speech are considered to have a single focused syllable, although there may be more than one. Tone units also are characterized by pitch movement from the focused syllable to the end of the tone unit.

Results

Research Question #1: How do the TAs use the knowledge structures of the written prompt in constructing their oral text, both the types of knowledge structures and the functions the structures serve?

We can assume from the research task that the targeted genre was the same for all teaching assistants in that we asked for a short lecture. We thus examined how the TAs built up the meanings of the topic they were presenting, and we were able to investigate this by exploring how the TAs constructed the taxonomies relevant to the topic, how they represented concepts of events and sequences, including causal relations, and how they related these to human consciousness.

The American TAs. The American TAs in general delivered their lectures following the same basic flow as the prompt. That is, there was a move from defining or qualifying or classifying (C/D), through a combination of qualifying, defining, and

elaborating (both C/D and P/S), to a restatement of what the speakers considered the key information, which they phrased using language that was mainly characteristic of principles (P/S). Within their lectures, there were moves from classifying and defining to giving examples in cause/effect language in order to elaborate on the information. The following excerpt, from TA A-4, illustrates this trend:

> Well the calories **are** a measure then of how much energy that food **has** in it. [C/D] So we *eat* the food, *burn* the calories, and it *gives* us energy. [P/S] (A-4)

At the end of the lectures, the American TAs summarized the principles presented in their talks (e.g., the reasons and the whys), just as the prompt had (see Table 2).

Although the American TAs used the same flow of knowledge structures that the prompt exhibited, there were some differences among the speakers. For example, not all American TAs defined energy or asked for a definition near the beginning of their talks, even though each used language characteristic of classification and description to set up a taxonomy of energy types and elaborate on this taxonomy in some way, in some cases by further defining the type of energy, or offering an example of the energy type. Some went into detail about what a particular energy type causes or does (i.e., P/S). Only two speakers, A-3 and A-4, included all six types of energy mentioned in the prompt. The energy types addressed by the other two speakers were not always elaborated on in the same way. Some speakers defined some energy types and gave examples of others. Some elaborated causally without defining.

Table 2. Knowledge Structure Analysis for American TAs

Speakers	***Beginning***	***Middle***	***End***
A-1 A-2 A-3 A-4	C/D	A general back and forth movement between C/D and P/S	P/S (although the final words also use language characteristic of C/D, such as *"that **is** why…"* or *"the important thing to realize **is**…")*

The least complete taxonomy (from TA A-1) displayed verbs of sensing to build a taxonomy of energy. This TA appealed to the students' commonsense ideas to introduce an important concept, that of conversion, which was a prominent part of the presentations of all the American TAs. In other words, A-1 adhered closely to the prompt in terms of its progression of knowledge structures by introducing energy and qualifying it (although he did not define the term). He then moved to a classification of energy types before bringing in the concept of conversion and describing it using linguistic resources of causality, such as if-then clauses (P/S). Speaker A-1 concluded by using a causal construction that restated his key idea (a thinly veiled reference to the wording of the original text): "without energy we lose the capability to do work" (P/S). Moreover, his later elaborations of common characteristics, through his use of repetition, addressed the commonsense taxonomy that he had set up earlier, constructing a connection between students' everyday understandings of energy and the more scientific view that future lectures promised to offer.

Speakers A-2 and A-3 elaborated on types of energy. A-3's lecture, although not the longest, was the most structurally well organized, with three main concepts introduced: energy as the ability to do work, the types of energy, and conversion. He presented two terms he would be discussing (energy and work) and defined both, then introduced a taxonomy of energy types, frequently offering definitions (C/D) and examples (P/S) to elaborate, as the following excerpt shows (The language features of C/D are in **bold** and those of P/S are in *italics*.).

> Now the **first energy example is** kinetic energy, and this **is** energy of motion. For example, *once* a car *is driving* on the highway, it *can do* work in terms of damage *if it runs into* something… Another **type** of energy **is** potential, and this **is** stored energy… *If you wind up* a spring, you *can hold* it there *for a certain amount of time*…(A-3)

A-3 also addressed how the types of energy related to each other through conversion, describing three examples using causal language (P/S) to help explain the concept (e.g., "nuclear energy *is also used* today *to create* electricity"). A-3 concluded his lecture

by qualifying terms and by restating his three main concepts in a means-end construction ("you need energy to do work").

The Chinese TAs. The Chinese TAs, like the American TAs, differed individually with regard to how they structured their texts, although there were general tendencies as a group (Table 3), starting and ending with C/D, but with the inclusion of E/Ch Knowledge Structures.

As can be seen, most of the Chinese TAs began by addressing the definition of energy, although C-2 began his talk by assuming what the audience already knew about the topic and then moved from that to the introduction of a taxonomy of energy types. Of the five who defined, three participants played with the same definition that appeared in the prompt, describing it as "a peculiar quality," "a peculiar quantity," or a "peculiar thing," with no further elaboration to suggest that they understood the meaning of the word "peculiar." In fact, the Chinese TAs were the only group to make use of this term from the original text. The American and Indian TAs avoided this term. One Chinese TA acknowledged the difficulty with the definition given in the prompt by suggesting that "maybe it's very difficult to formalize the definition of this word." Although attempts at definitions differed, just as with the American TAs, all Chinese TAs attempted to present a taxonomy of energy types early in their talks.

As with the American TAs, the Chinese TAs varied in their movement between definitions/qualities (C/D) and examples (P/S) in the middle of their lectures, although all made these back-and-forth movements in some way, as Table 3 suggests.

Table 3. Knowledge Structure Analysis for Chinese TAs

Speaker	***Beginning***	***Middle***	***End***	***Examples of the End***
C-1	C/D	A general back and forth movement between C/D and P/S	C/D	*…any questions…?*
C-2	E/Ch		C/D	*that**'s** the main point*
C-3	C/D		E/Ch	*I hope you can read some external materials…*
C-4	C/D		C/D (new information)	*we* have to keep *the source… for our child…*
C-5	C/D		C/D	*that**'s** what I got to show…*
C-6	C/D		C/D	*…any questions…?*

C-1, C-2, and C-4 offered a taxonomy of energy types as a list, without elaborating on each type as they were mentioned, similar to what was in the written prompt. Of these three, only C-4's taxonomy was complete as compared to the written prompt. C-2 offered five types and C-1 four types plus "a lot of other kind." The other three speakers attempted to combine the list of energy types with definitions and/or examples (as American TAs A-2 and A-3 had done). Speaker C-3 offered four types, illustrating three of them with definitions and one with a causally stated example. Speaker C-6's taxonomy was similar to the prompt in that it contained only two types of energy, but he used types he had not mentioned to illustrate concepts of conversion and energy sources (which the Chinese speakers as a group did not elaborate on well), causing confusion because he was using undefined examples to explain new concepts.

While Chinese speakers had lexico-grammatical issues at various points in their texts (which will be discussed in research question #2 below), many of these were in fact problems with their construction of knowledge structures, creating serious confusion with meaning. These most notably occurred as loose definitions (difficulties constructing C/D), faulty logic (difficulties constructing P/S), or the introduction of terms that had not yet been used by the speaker (a lack of clear definition). An example of a loose definition combined with faulty logic was when C-1 said, "the energy source **is** just a source of energy… it **is** some some thing or some kind of object that *can supply* energy *so that cause* the energy sources." In making an attempt to describe the chain of energy, C-2 suggested that "the energy from the food **is come is com*ing*** from the photosynthesis then *finally* the energy **is** from the sun," yet he has not introduced the concept of photosynthesis or made a clear causal-sequential relationship, which is necessary to describe a causal chain (P/S). Speaker C-3 talked about "the chemical energy energy that **contained** the battery" (Which entity does the containing?) and C-4 stated that "the food in our body will detect from to the chemical engineering." These errors can be examined at the sentence level as simple mistakes in form. However when the errors are brought to the level of knowledge structure, they result in flawed meanings that make it more difficult for the listener to follow the speakers' arguments.

One of the most noticeable differences distinguishing the Chinese TAs from the American TAs was the knowledge structure of the conclusions. Whereas the American TAs concluded their lectures with restatements of key information constructed in causal language (P/S Knowledge Structures) in much the same way as the written prompt, the KSs in the endings of the Chinese TAs' texts suggested a very different idea on their part about what was important. For example, C-5 concluded his talk by summarizing what he felt was key information in C/D language and sensing verbs (Language of C/D is, as before, in **bold**; language of P/S is in *italics*, and the language of E/Ch is underlined.).

> I think there **are** many other examples of mm the transformation and utilization of um energy in our life and I will just show these two examples. And the *finally at the conclusion of this lecture* we can see that um the energy **is** quite important in our life. And that**'s** what I got show in this lecture. Thank you. (C-5)

As a group, the Chinese speakers tended to restate their key information in terms of quality or classification—with one TA favoring the language of evaluation and choice—thus creating endings that downplayed the importance of the causal elements which are so critical to science discourse. This can be seen in conclusions such as "so this **is** energy and energy source" or "we **have** different forms of energies and the ener after ener the basic assumption of the energy **is** to do work." Speaker C-3 ended his talk with "So I hope you you you can *read* some external materials about this topic *after class*," which involved the language of evaluation and choice, offering no reiteration of key information. As an ending strategy that differed from the others C-4 concluded by introducing a new topic:

> …at last of the lecture I want to emphasize a very important concept **is** save the energy *because* energy **is** a limited resource in the world *so* this **is** a very treasured end resource we **have to uhh keep** the source of energy and this resource for our child…(C-4)

The Indian TAs. Unlike the Chinese or American TAs, none of the four Indian TAs opened their talks with an early attempt

to define energy, although most of their beginnings used the language of classification and description in some way, along with language typically associated with evaluation and choice to introduce the topic (Table 4).

Speaker I-1, after commenting about the weather and connecting that to a lay concept of energy ("the sun actually *gives* me so much energy"), requested a definition from the audience, then offered what he called the layman's definition of energy ("nothing but work"). He did not address the scientist's or engineer's understanding despite suggesting that there was a difference ("how does an engineer actually understand what **is** energy?"). Speaker I-2 continued from his first utterance (Table 4.) by positing that the audience would be familiar with the term in an everyday sense, and that the meaning was more or less the same as the technical sense, but "more specifically defined in Physics." Yet he never went beyond this statement, never defined energy, and turned instead to a list of energy types. Neither of the remaining two speakers' texts contained an attempt to define energy.

Instead of defining energy types or giving examples, all four Indian TAs offered simple lists. One reclassified the list into three main types of energy before moving to a brief but confusing discussion of conversion. Three offered a straightforward list of energy types, and two went on to describe conversion (albeit

Table 4. Knowledge Structure Analysis for Indian TAs

Speaker	***Beginning***	***Example of the Beginning***	***Middle***	***End***
I-1	C/D, E/Ch	Uhh well as you can see today **is** a very good atmosphere outside.	Some movement between C/D and P/S	All but I-1 (who used P/S) used C/D to end on, but all introduced new information at the end.
I-2	C/D, E/Ch	Uhh, so today I'll be talking about introducing two **terms** to you all: energy and work.		
I-3	C/D, E/Ch	Uhh today we'll be looking uhh at what energy **is** all about.		
I-4	C/D, E/Ch	…uhh today we'll be talking about a concept **called** energy		

not to the extent that the American TAs did). One speaker did not offer an early list, but named the six types near the end of his talk, after addressing the differences in understanding between a layperson and an engineer, and then listed them as forms that students "must have heard about in your twelfth grade or eleventh grade class."

The middle parts of the Indian TAs' texts evidenced movement between classification/description and principles/sequence but not to the same extent as the American or Chinese TAs. For example, I-1 offered limited ideas posed in P/S terms until the final seconds of his lecture, and these ideas were that food "makes me hungry" (in lay terms) and "food gives us a kind of energy" (as what an engineer might understand). Most of his talk was in the form of classifying. Then at the end, he introduced the concept of solar cars, described them, and talked about them in the language characteristic of P/S. Whereas I-1 spent most of his talk using C/D, the opposite could be found in I-3's text. Other than listing the types of energy near the beginning of his talk, I-3 mostly gave examples to describe what the energy types do, thus making use of the language of principles and sequence (P/S) before ending his talk with a new idea expressed in C/D language ("…it's going to be a hard place to live in").

The one strategy characteristic of the Indian TAs as a group was the introduction of a new idea just prior to ending. Speaker I-1 introduced the topic of solar cars, then concluded by saying "if you want any work in this universe you need energy," which had been previously discussed. Likewise, I-2 concluded his presentation by introducing and explaining the food chain. Speaker I-3's final comment was that "without energy we'll be barely to able to any kind of work and it's going to be a hard place to live in," information that had no earlier mention. Speaker I-4 said that there were two ideas to take from the lecture—why energy is important and how work is related to energy—although neither had been addressed.

Summary and comparison of the three groups for RQ #1. To sum up, while there were differences noted with individual TAs within the groups, there were also trends that characterized the groups we examined. We summarize these main group differences in Table 5.

Implications for ITA educators. Whereas language teachers may feel the need to focus on pronunciation or sentence-level grammar issues, this basic knowledge structure analysis suggests that a useful strategy is to help the ITAs understand how the prompt (the text they are using as a basis for teaching) is constructing knowledge and to work with them to expand on the same patterns they see in the text. For this text—as for many science-related texts—the knowledge-building begins with a term that represents a category ("energy"), which needs to be defined, put into a logical taxonomy of items, and explained and related to each other in some way, before the speaker can sum up the key relational points s/he wants the audience to remember. The American TAs did this, but the Chinese and Indian TAs did not.

Research Question #2: What kinds of lexicogrammatical resources do the TAs use to convey the information in their spoken texts?

In the previous section, we noted that the Chinese TAs had more trouble constructing individual knowledge structures than did the U.S. and Indian TAs. In this section, it is not our intention to describe problematic sentence-level lexico-grammatical issues. Instead, rather than focusing on what the TAs could not do, we aim here to examine the resources of English that they *did* use.

Table 5. Knowledge Structure Summary for Prompt and Three TA Groups

Group	*Beginning*	*Middle*	*End*
Prompt (Figure 2)	C/D	From C/D to P/S	P/S
American TAs	C/D	Back and forth between C/D and P/S	P/S
Chinese TAs	C/D (several speakers used definition verbatim from prompt)	Back and forth between C/D and P/S, but difficulties with the construction of these knowledge structures	C/D (simple restatement)
Indian TAs	C/D (no definitions) and E/Ch	Limited back and forth movement between C/D and P/S	C/D (introduction of new information)

By comparing the groups of speakers in this fashion, we hope to gain insight into the differences so as to inform ITA educators.

Vocabulary richness. There were differences in vocabulary richness amongst TA groups and individual speakers, as Table 6 below shows. The number of unique words per one hundred spoken was somewhat different amongst the group as aggregates, with the Chinese TAs lower than the other two groups. Individual speakers who had higher numbers of words, however, did not necessarily exhibit the broadest vocabulary range as measured by their number of unique words. Numbers were calculated using the Compleat Lexical Tutor website, http://lextutor.ca/vp/eng/ (Cobb, 2011; Heatley & Nation, 1994). For instance, speaker C-1 had the fewest unique words per 100, a not surprising finding given our impression that he was repeating himself.

Table 6. Vocabulary Richness for Each Group of TAs

American TAs	*Total Words*	*Unique Words*	*Unique Words per 100 Total Words*
A-1	622	193	31
A-2	505	180	36
A-3	863	247	29
A-4	1466	349	24
Total for group	*3456*	*583*	*16.9*
Chinese TAs	*Total Words*	*Unique Words*	
C-1	582	124	22
C-2	625	150	24
C-3	1084	290	28
C-4	463	146	32
C-5	581	179	31
C-6	498	136	27
Total for group	*3833*	*529*	*13.8*
Indian TAs	*Total Words*	*Unique Words*	
I-1	475	159	33
I-2	1039	251	24
I-3	674	200	30
I-4	523	151	29
Total for group	*2711*	*450*	*16.6*

Note. Individual averages are rounded.

Relationship of word choices to audience familiarity. A revealing approach was to examine the kinds of words the groups of speakers used. Although there were efforts by speakers in all three groups to connect the items in their presentations with items that their perceived audience could relate to, the speech of the Indian and Chinese TAs held more examples of less commonly used nouns (e.g., "cooker") and of technical words (e.g., "metal wires," "rotating balls," "photosynthesis," "subatomic molecule levels") than the speech of the American TAs, whose vocabulary choices reflected more common terms related to the key "energy" lexis (e.g., "a light bulb," "a toaster," "a car engine"). Word choice by the Chinese and Indian TAs included more mentions of their imagined audience's previous education, such as "middle school" and "high school," arising from assumptions made about when they should have learned information relevant to the current topic. This supported Reinhardt (2007), who found that there are disconnects between ITAs' educational socialization (what they are used to and understand from their background experiences) and what they face in their teaching assistantships.

Use of "human" nouns. Despite being a science text concerned with a generally technical, non-human entity (energy), the texts of the Chinese and Indian TAs' speeches included many more examples of "human" nouns (e.g., "a kind of humans,""some people,""the villagers,""early man,""the layman,""the students") than the texts of the American TAs. Although it could be argued that this strategy was an attempt to make the lecture more connected to humans, when combined with pronunciation and knowledge structure issues, the introduction of vocabulary that the audience is not expecting to "fit" with the topic may lead to difficulties in understanding.

Use of nominal groups. The Chinese speakers of English used more than twice the number of vague nominal groups (phrases that included words such as "some," "bunch," "kind of," and "things") than either the American or Indian TAs. Nominal groups such as "some kind of peculiar quality that can show some capability of things" (C-1), or "a bunch of forms in which the energy exists" (C-6), added to the vague, non-scientific quality that these Chinese speakers' presentations at times had. Even

though American TAs used the same words, they used them in more carefully developed contexts, as in the American TAs' "some sort of energy source" (A-1), or "the right kind of energy to do the work that you need" (A-3).

The length of well-constructed nominal groups was also different between groups. The American TAs included several long nominal groups, such as: "energy that's stored from some other type of energy that was previously used to create a reservoir that can be used at a later time." The American TAs rarely got lost in these types of constructions. The Chinese speakers, in contrast, either used vague terms as previously mentioned, or became confusingly repetitive ("the bridge between two kinds of energies or more kind of energies"). Chinese TAs also ran into difficulties, such as the following 22-word attempt: "energy of motion that you see the cars run running on the road and some running the check running along the check" which is both repeti-

Table 7. Pronoun Use in the Prompt and in the TAs' Presentations

	we/us	***you***	***I/me***
Prompt	*3 (9.8%)*	*1 (3.2%)*	*0*
A-1	32	2	0
A-2	8	0	2
A-3	8	21	25
A-4	38	25	15
Total American	*86 (12.3%)*	*48 (6.9%)*	*23 (3.3%)*
C-1	21	0	24
C-2	9	12	13
C-3	24	26	6
C-4	22	6	4
C-5	5	8	10
C-6	10	6	9
Total Chinese	*91 (10.7%)*	*58 (6.8%)*	*43 (5.1)*
I-1	13	9	14
I-2	7	37	16
I-3	14	18	1
I-4	5	11	16
Total Indian	*39 (5.8%)*	*75 (11.2%)*	*47 (7.0%)*

tive and grammatically difficult to untangle. The longest of the Indian speakers' nominal groups was 14 words and was well constructed: "the work that I'm doing now with the help of this chemical energy."

Use of personal pronouns. Another pattern emerged concerning the use of personal pronouns, as Table 7 shows. In the prompt, "we," or the combination of "you" and "I" to imply "we," was the most common personal pronoun used, with three tokens of "we/us" and one of "you." The pronoun "I," on its own, was not used. Like the prompt, the pronoun "we" was the most frequently used by the American and Chinese TAs. The Indian TAs, however, showed a strong preference for "you." They also frequently used "I" or "me," the least preferred by the American and the Chinese TAs.

Language of processes. Still keeping in mind the difficulties involved in simply comparing numbers of language features used

Table 8. Being/Having, Doing and Sensing verbs in the prompt and the presentations

	Being/having	***Doing***	***Sensing***
Prompt	*50%*	*42%*	*8%*
A-1	26%	54%	20%
A-2	68%	25%	7%
A-3	49%	38%	26%
A-4	51%	23%	26%
Total American	*47%*	*34%*	*19%*
C-1	55%	36%	9%
C-2	46%	29%	25%
C-3	42%	31%	27%
C-4	40%	24%	36%
C-5	48%	29%	23%
C-6	48%	28%	24%
Total Chinese	*46%*	*30%*	*24%*
I-1	37%	26%	37%
I-2	62%	23%	15%
I-3	32%	46%	22%
I-4	37%	28%	35%
Total Indian	*43%*	*31%*	*26%*

(as if the effectiveness of their use were not important), we also compared the kinds of processes appearing in the prompt to those used by the three groups of speakers. In doing so, we found that half of the processes used in the prompt represented concepts of *being* and *having* (e.g., "is," "are," "has"), forty-two percent as *doing* (e.g., "put," "do," "produce"), and eight percent as *sensing* (e.g., "think," "hope," "like," "see"), as Table 8 shows.

Given Halliday's observation that scientific discourse involves constructing taxonomies and relations, these numbers come as no surprise. Although there were differences in the percentages used by individual speakers, all three groups mirrored the prompt in that processes of being were the most frequent and those of sensing were the least. But there was an interesting difference between the American TAs and the Indian and Chinese TAs: The percentage of sensing verbs was higher by five and seven percent by the Chinese and Indian TAs, respectively. This suggests that these groups may be overusing verbs such as "think" and "hope" compared to the American TAs.

Use of modals. Related to verb use was the use of modals (see Table 9). There were differences between groups in this area as well. The prompt showed one example of "can" ("electric motors

Table 9. Modal Auxiliary Use by Three Groups of TAs

Speakers	*Can/ Able to*	*Will*	*May/ Might*	*Must/ Has to*	*Should*	*Would*	*Could*	*Totals*	*Tokens per 100*
A-1	4/0	0	0/7	0	0	0	0	11	1.76
A-2	0/2	0	1/2	0	0	2	1	8	1.58
A-3	14/0	5	0	0/2	0	0	0	21	2.44
A-4	4/0	5	0/2	0/2	0	4	0	17	1.17
Total A	*22/2*	*10*	*1/11*	*0*	*0*	*6*	*1*	*57*	*1.66*
C-1	18/0	2	0	0/1	0	0	0	21	3.69
C-2	7/0	1	0	2/0	0	0	0	10	1.62
C-3	15/0	2	2/0	0/2	0	0	0	21	2.04
C-4	22/0	4	1/0	0/1	0	0	0	28	6.05
C-5	6/1	19	0	0	0	0	0	26	4.55
C-6	0/1	0	1/0	0	0	1	12	15	3.03
Total C	*68/2*	*28*	*4/0*	*2/4*	*0*	*1*	*12*	*121*	*3.23*
I-1	2/0	4	0	1/0	0	0	0	7	1.47
I-2	15/8	6	0/5	1/1	6	0	0	42	4.04
I-3	5/0	5	0	4/0	0	0	0	14	2.07
I-4	0/2	1	0	0	1	5	1	10	1.91
Total I	*22/10*	*16*	*0/5*	*6/1*	*7*	*5*	*1*	*73*	*2.65*

can do work because…" and one of "would" ("the capability of doing work would cease to exist"). "Can" was the favorite of all groups, but was especially favored by the Chinese TAs, who used it over three times more than either the American TAs or the Indian TAs. The term "would" rarely appeared in the texts of the Chinese TAs, but was used about the same number of times by the American and Indian TAs. The modals "could" and "will" were also favorites of the Chinese TAs, whereas the American TAs favored "might" and the Indian TAs liked "should" more than the other groups did. In general, five of the six Chinese TAs used the most modal verbs. This amounted to more than two modal verbs per 100 overall words, whereas only one of the American TAs and two of the Indian TAs used that many. Adding modal verbs in the text this way thus created a sense of uncertainty in many of the Chinese texts.

Summary and comparison of the three groups for RQ #2. This research question examined the kinds of lexico-grammatical resources that the different groups of TAs used to construct their spoken texts from the written prompt. It was found that vocabulary richness, although different amongst speakers, appeared to be less noticeable in the lectures than the kinds of words used in terms of familiarity, vagueness, and grammatical difficulty (the latter concerning specifically the length of nominal groups). The use of personal pronouns and modality also differed, as did the types of verbs favored. Despite the small sample size, the findings supported work by other researchers dealing in the register of science who suggested that the ESL students' lack of grammatical resources may result in their "conveying attitudes that they do not intend to convey, or presenting information in ways that lack cohesion" (Schleppegrell, 2002, p. 141).

Implications for ITA educators. These findings lead us to suggest that instructors of ITAs need to bring their students' attention to the differences between technical and less commonly used words on one end, and the casual terms such as "things," "stuff," "some kind of," personal pronouns, and modal verbs on the other. We suggest instructors discuss with students how the combination of these two very diverse linguistic elements can confuse their listeners and detract from the science information they are trying to construct.

Research Question 3: How does the prosody that the TAs use affect and influence the presentation of the information in the spoken texts?

Creating coherent spoken discourse requires skills that do not have written counterparts. The ability to use prosody to build a coherent message is the most important of these skills, and it is the area in which we noticed the most consistent differences between the three sets of TAs. We saw differences in the way TAs used focus to call attention to distinctions between new and given information, and in how they called attention to contrasts, both between words and in constructing the organization of the spoken discourse. We also found differences in the ways voice pitch was used to background information.

General group comparisons on prosody. The American TAs used prosody to organize information. To do so, they made use of variations in syllable length and a greater pitch range, consistently using a noticeably higher voice pitch for focus on contrasts and on new information, while using noticeably lower pitch for de-stressed old information. American TAs also sometimes used pitch that was extremely high for topic shifts. We also found that American TAs used short phrases stylistically to mark multiple words as important through a combination of multiple focus points and a slower rate of speech.

Indian TAs, on the other hand, used a relatively narrow pitch range. We did not notice them using distinctively higher and lower pitches in informationally significant ways. Because their narrow pitch range made it difficult to distinguish more from less important information, we had trouble identifying potential syllables that were in focus while listening along with the transcripts. At the same time, Indian TAs used accent patterns in which stressed syllables were spoken with a lower pitch and unstressed syllables spoken at a higher pitch (Pickering & Wiltshire, 2000), causing us to mishear stress of multisyllabic words.

Chinese TAs were more inconsistent than either the Indian or American TAs. It was often difficult to identify their focus because so many words were spoken as relatively prominent. In addition, Chinese TAs were more variable than the other two groups in their control of spoken grammar. Not only did they

speak more slowly and use fewer words per tone unit, their longer tone units were more likely to include repairs (such as repeated words and phrases) rather than expansions (such as definitions).

American TAs: New and given information. *Energy* was the main topic of the prompt. As such, we expected it to be repeated frequently in various combinations in nominal groups, and it was with this group. Phonologically, we also expected the American TAs to move from using focus on *energy* to de-stressing it in favor of new information related to the topic in subsequent mentions. We found this to be the case. In the excerpt below, *energy* and its pronominal forms are **bolded** to help trace its use throughout the introduction. *Energy* starts in focus (shown by underlines), but then is backgrounded by being de-stressed with other words being in focus. In the data, we marked noticeable tone unit breaks in the speech with slash marks. The tone unit breaks were signaled in a variety of ways, sometimes with an obvious pause, sometimes with pitch movement, and sometimes with final lengthening. Two of the authors listened to the presentations multiple times until both agreed on the boundaries of tone units. Not all tone units had focused words and some tone units had more than one word in focus.

> Alright / one of the things that that we / concentrate on in physics / and an important concept to us / is that of **energy** / and we're going to try to take / a step back and try to introduce **energy** today, / when we think of **energy** one of the things that uhh / comes to mind / or comes to a lot of your minds / might be electricity / uhh some of you might think of **energy** in the form of uhh heat / or other others might think of **energy** in terms of / wow, I barely have enough **energy** to stay up tonight and study for my physics test / each one of these forms of **energy** / whether we think of **it** as electricity / or electric **energy**/ uhh whether we think of **it** as light **energy** / light being uhh coming from the sun / or whether we think of **it** as being / uhh / heat / or simply the **energy** needed to stay up / late at night and study / for the physics test / each one of these / is correct / each one of you / when you think of these things / that's a form of **energy** / so one of the things that we can immediately realize with **energy** / is that **it** comes in a vari- / wide variety of forms / (A-1)

Energy is used 12 times in 206 words and is also referred to four times by the pronoun *it*. Of the 12 nominal uses, *energy* occurs at the ends of phrases (considered to be the default focus position) six times. However, it is actually in focus (stressed) only twice: the first time and the next to last time it is used. Otherwise, *energy* is de-stressed (e.g., *introduce energy today, think of energy*). At the discourse level, *energy* was also moved out of the default focus position at the end of phrases and used toward the beginning of the phrases. Phonologically, this promoted the word not being in focus.

This pattern is what one might predict. Because *energy* was the topic, it was marked first by focus, but subsequently was pushed into the background and de-stressed in favor of information that was not already known. This allowed the topic to be continually mentioned, but marked as non-salient. The same pattern occurred in other NTA presentations.

Indian TAs: New and given information. Indian TAs, whose spoken grammar was very similar to that of the American TAs, did not use focus and de-stressing to distinguish between new and given information. The excerpt below is structured similarly to that of the American TA above, but perceived focus never shifts. Again, *energy* and related words are in **bold**, and words one would expect to be in focus are *italicized*. However, the underlined ones actually were heard as more prominent (stressed). The pattern seemed clear to us: Words heard as being in focus were at the end of the tone units.

> how does an engineer understand that food gives you an **energy**? / Well actually food gives us a *kind* of **energy** / we say *chemical* **energy** / but these are just some some *forms* of **energy** / and I'll explain what are the *different* forms of **energy** / and that comes in later, / later part of the lecture but / the food gives us chemic *chemical* **energy** / and basically we *use* this chemical **energy**… (I-1)

Chinese TAs: New and given information. Chinese TAs were inconsistent as a group in their use of focus. One was indistinguishable from the American TAs, and two were so dysfluent that identifying focus was not possible. Others varied from some use of focus to almost no identifiable use. The example below

showed consistent focus on the last word, with the word *laptop* being repeated and always in focus.

> uhh let's give let's think about if you have a laptop / you want it to work /you have to find a cord / and plug plug it in / so it's the electricity supply that powers your laptop / but if you don't bring any cord / or you cannot find an outlet in the wall / you just use the battery to power your laptop / also it's the chemical energy / energy that contained the battery / that makes the laptop works / so just you can see that here / our source of energy / is electricity / and we turn it to make it turn it to another form that that powers the laptop (C-3)

Interestingly, the same TA later used an almost verbatim quotation from the prompt and used focus in a completely native-like way, de-stressing the old information following the focus in the second and third tone units:

> no matter what form of work is done / an energy source of some form / is very needed to accomplish the work

Our results suggested that Chinese TAs are far from native-like in their use of English, but that as their fluency improves (Anderson-Hsieh & Venkatagiri, 1994), their use of spoken focus becomes more promising. Most Chinese participants appeared to at least sometimes mark syllables in a way that is consistent with American use of focus. This suggests it may be possible for them to acquire this element of English prosody.

American TAs: Focus and contrast. The American TAs used focus to highlight contrasts and organize their presentations. Three of the American TAs did this in an obvious way, organizing a portion of their presentation around the different forms of energy in the original text. Their use of focus followed a pattern emphasizing the different names of the forms of energy, thus causing focus placement to consistently fall on the name of the form rather than *energy*. This is different from the focus pattern seen for the overarching term, *energy*. The American speakers never de-stressed the form of energy when it was repeated. This suggests that they were using focus as a discourse organization strategy, highlighting contrast between the forms of energy, with the contrast marked by focus. This kind of repetition in

text is relatively unstudied when it comes to focus placement, although it has been an important research area in discourse analysis (e.g., Tannen, 1989). In the example below, the key terms for this discussion are marked in **bold**, and the focus words are underlined.

> **Kinetic energy** / this first example / is probably / the most umm / he most easy to understand / **kinetic energy** is energy due to motion / energy due to motion / for example / running / playing a game / walking to class / this is **kinetic energy** / you're moving your body / **Potential / potential energy** / is an example would be a counter weight / in an elevator system, / the counter weight is at a very high level / and has the **potential** / to convert umm all of its energy into uhh **kinetic energy** / **Nuclear energy** harnesses the inner- / the sub atomic interactions / to produce work. / **Chemical energy** / a great example of **chemical energy** would be / the digestion of food in your body / this is uhh / your body basically do is is exerting energy to produce work / and the result of which is your / digested digested food / And the last example is **heat energy** / **heat energy** is umm umm / what might for example heating up a metal might cause it to expand / (A-2)

One striking thing in the passage is the American TA's resistance to placing focus on new information, even when it is possible. Instead, he invariably placed focus on the forms of energy, even when they were not at the end of a phrase and when there were other available candidates. For example, when the speaker said "Chemical energy / a great example of chemical energy would be," the second phrase has multiple candidates (*great, example, be*), yet the focus falls on the contrasting form (*chemical, chemical*). Toward the end of the section, the speaker abandoned another choice for focus placement where he said "And the last example is heat energy." Placing focus on *last* as an organizational strategy to signal the end of the examples makes sense, but the speaker did not do so, and kept attention on his overall organizational strategy.

Although most American TAs used contrast as a single organizing strategy, multiple contrasts were also evident, as in an interesting focus placement on function words by one speaker. In the example below, the speaker used repeated focus on *we/us* (in

bold) to draw a contrast between the machines that use energy and us, the people that use energy. This use of focus seemed to draw attention to the speaker's intention that "people" and "we" are like the machines that he has been talking about in that we use energy to do work. As a result, the use of focus to highlight contrasts personalized the message being communicated. In one of the tone units, the speaker put focus both on *we* (his secondary contrast between machines and people) and on *chemical* (his primary contrast on the forms of energy).

> now the the one last one that I want to get to / is the chemical / and that is because people / **we** / in order to do any form of work / need to produce energy as well / and energy that **we** use is from chemical / and I'll just put **us** next to here [the TA draws a person on the board next to the words chemical energy] / people convert energy from the food that **we** eat / mostly from the break down of sugars and starches / to perform the work that **we** do / (A-3)

Indian TAs: Focus and contrast. Indian TAs did not appear to call attention to contrasts in a way that was identifiable. In the example below where the grammar signaled obvious contrasts, there was sometimes emphasis on one word (not the contrast) only, and sometimes on both the contrast and the other word. Notice that at the end of the section, each of the forms of energy is listed in its own tone unit (marked by /) but there was no distinguishable difference between the form of energy and its hyponym, *energy*.

> how does that motor work / well for electric motors, / electrical energy works, / so for an electric motor, / that electric motor needs electrical energy. / Again, this again is a form of energy. / Well I'm talking about forms, / why not explain / what are the different forms of energy…. / well let me enumerate one of some of them. / With kinetic energy, / we all know what is kinetic energy, / potential energy, / heat energy, / chemical energy, / nuclear energy, / and electric energy. (I-1)

There may be an explanation for the lack of perceptible focus for contrasts for the Indian TAs. In most phrases, no words stood out as being in focus, but words often seemed mis-stressed within

themselves (*poTENtial* versus *POtential)*. One reason for this may be the lexical accent pattern used by the speaker in his variety of English. Pickering and Wiltshire (2000) found that speakers of American English, in marking lexical stress, reliably used higher pitch (frequencies in Hz) on stressed than on unstressed syllables. That is, stressed syllables next to unstressed syllables were typically spoken at a Hz range about 20 percent higher than for unstressed syllables. Indian English speakers, on the other hand, marked lexical stress with the opposite pattern. Their stressed syllables were spoken at a Hz level approximately 30 percent *below* that of neighboring unstressed syllables. Pickering and Wiltshire pointed out that the two ways of marking lexical stress are mirror images of each other. As a result, American English listeners will likely hear Indian English speakers as mis-stressing words, and not marking focus, which is dependent on lexical stress. We found much evidence of the word accent pattern described in Pickering and Wiltshire (2000) in words such as *engineer, atmosphere*, and *equivalent*. When one speaker listed out the forms of energy, we heard the word *energy* stressed on the final syllable (*enerGY*), a pattern that connects stress recognition to higher pitch, as in American English. But in Indian English, the lower pitch on the first syllable of *energy* would correlate with the speaker's own Indian English variety norms of proper lexical stress. In terms of recognition, however, we as American English listeners heard the word as mis-stressed.

Chinese TAs: Focus and contrast. The Chinese TAs again were inconsistent as a group. They seemed to produce focus on some contrasts while other contrasts were not marked. One presenter produced focus on some contrasts, especially in a section in which he twice used a parallel group of three verb phrases with sensing verbs, as in the example below. Not only was his focus on contrasts effective, he also used body language at the same time he used the focus (pointing to his eyes, his ears, and sniffing the air).

> energy / has some different form, / you may say / we can not see the energy, / we can not hear the energy / and we can not smell the energy, / how can we detect the uhh detect or measure that energy, / uhh actually / yes / you are right /

we can not see that / we can not smell that / we can not hear that / but we can see some result (C-4)

The same presenter, however, did not effectively call attention to contrasts in the forms of energy. Instead of focus on the form of energy, he put focus on both the form and on *energy*.

Even the Chinese presenter who used the most American English-like prosody showed inconsistency in his ability to call attention to contrasts. In the first example below, his prosody led us to expect that he would present both points two and three (marked with sole focus in a single tone unit), when in reality, he was correcting himself. The use of *and* increased the confusion since it signaled addition rather than contradiction.

o every object will have heat energy / the only difference / is / they will have more or less heat energy regarding with their temperatures, / high or low, / **and second and the third,** / nuclear energy, / nuclear energy means umm when some specific atoms / depart from each other (C-5)

Later, however, he corrected himself both with the correct vocabulary and the correct focus pattern, shown below:

it will be able to move the metal wires that carries the electricity / that shows how electric electric power / **I mean electric energy** /

Implications for ITA educators. The prosodic analysis showed that it is of course important for TAs to learn the discourse and lexico-grammatical tools necessary for their teaching. But it is also important for them to learn how to use prosody to package the spoken information in a way that helps listeners understand relative importance of information. Some newer ITA books address this need explicitly (e.g., Gorsuch, Meyers, Pickering & Griffee, 2010), but it is still common for pronunciation work (e.g., vowels and consonants) to begin and end with features that do not promote clear expression of textual meaning.

Conclusion

The overarching question motivating this study was how TAs turned written language into spoken. The task, teaching a written prompt in spoken language, was intended to help us understand the kinds of strategies employed by native speakers of English as a mirror against which to understand how two other groups of TAs performed the same task. The choice of TAs from China and India was important because of the numbers of TAs from these countries, but also because they represent speakers from two contexts: 1. where English is a foreign language, and whose English learners vary widely in their spoken proficiency (China); and 2. where English has an official role, with learners whose spoken command of English (at least in North American graduate programs) is at a high level (India).

Use of the Written Prompt in Spoken Language

One finding was that TAs from all groups varied in how much they used the written prompt in their presentations. Evidence of verbatim use of the written text occurred for all three groups, though for most of the American TAs this was unusual and only happened with inexperienced teachers. Indian TAs also made verbatim use of the written prompt, but less noticeably so because of their ability to expand on the prompt. Chinese TAs, on the other hand, relied more heavily on the written prompt.

The ability to expand on the prompt was, we think, closely tied to two areas: vocabulary knowledge and spoken fluency. The Chinese TA who had the fastest speech rate and was in the top half of the speakers in total words used in the presentation nevertheless had the most impoverished vocabulary, only using 124 unique words out of 572 total words[2]. For comparison, one of the inexperienced American TAs had 193 unique words and 622 total words, and another Chinese TA used 179 unique words out of 581 total words. It was no surprise that the speaker with the weakest vocabulary also seemed dysfluent, with frequent repetitions and repairs. Working with such a student on pronunciation is likely to pay small dividends if his vocabulary needs are not

[2]Contact the lead author for descriptive statistics for this analysis which did not appear in this chapter.

addressed. Three of the six Chinese TAs were the only TAs to use the word *peculiar* from the prompt, but they used it in a way that suggested that they did not really understand the word. It was suggestive that the three TAs that used *peculiar* all had the most limited vocabulary counts.

Use of Information Implied but not Directly Stated in the Prompt

Another difference amongst the groups was the extent to which they taught content implied by but not specifically mentioned in the prompt. The clearest example of this was *conversion*. All of the American TAs made the notion of *conversion* a prominent part of their presentations. The Indians all included the concept as well, though they did not expand on it to the same extent. Only three of the six Chinese TAs included it, and none expanded it much. ITA educators could emphasize working on ITAs' ability to expand topics beyond the written text and make connections that are important to fuller understanding by U.S. students. However, we think simply mentioning connections is not enough. It is likely important for all TAs to be able to "unpack" a concept for the American students in their classes. Important concepts are not likely to be understood by novices in the field (the students) by simply mentioning them.

The use of information that was not even implied by the prompt occurred for all three groups of TAs. The American TAs showed this clearly in connections to the presumed audience's lives both in their majors and outside the classrooms. They made references to mp3 players, video games, toasters, and vacuum cleaners, among other things, which served to connect the topic *energy* to commonsense uses of energy that students would be able to understand. Indian and Chinese TAs did this as well, but not in the same way. They were more likely to use obscure examples such as cookers, metal wires, and rotating balls. In addition, the American TAs tended to expand on their examples, explaining and connecting them to the concept being considered, whereas Indian and Chinese TAs were more likely to mention examples briefly and then move on, leaving listeners to make the connections themselves.

Indian and Chinese TAs also showed a lack of understand-

ing about their imagined audience. A substantial number tried to make connections by talking about how the topic should have been learned in high school or middle school. Misunderstanding what students in introductory classes bring to the class in the way of background knowledge serves as a reminder that ITAs need a clearer view of who their students are.

Indian TAs used outside information in a surprising manner. Rather than reiterating the main points of their earlier presentation, they included new information as part of their conclusions. The net effect may leave listeners confused about how this information fits into the knowledge structures they have already built up. Chinese TAs also showed this tendency, but most seemed to present evaluative statements such as the need to conserve energy for our children's sakes, rather than presenting completely new topics that seemed informationally equal to what had gone before.

The Role of Pronunciation in Communicating Meaning

It was also evident that some pronunciation features played an outsized role in helping communicate meaning. The American TAs structured their discourse partly through grammar and repetition of key points, but more so through their use of prosodic strategies to highlight certain information as salient and to deemphasize other information, thus guiding the listener through the flow of the information. Neither the Indian nor the Chinese TAs used these strategies in the same way. Perhaps this area is most important for the Indian TAs. While their lexicogrammatical command of spoken English was very similar to that of the American TAs, the Indian TAs in this study did not package their spoken English in a way that was likely to be understood by native listeners, leaving their message to be muffled by unfamiliar prosody.

Future Research

This study has provided comparisons of groups of TAs in how they turn written language into spoken, but other issues are in need of investigation. For example, we have assumed that the students taught by these TAs are all speakers of North American English. However, this is not true in STEM (Science, Technol-

ogy, Engineering, and Math) classrooms. For example, Chinese undergraduate students have often told us of their difficulties in understanding their Indian TAs. Clearly, we need additional research about how varied undergraduate students understand varied speakers, not just how native speakers of English understand nonnative TAs. All TAs need help in becoming effective teachers, but not all need help in the same way.

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Appendix A

Subjects' identifiers and demographic information

Identifier	TA Group	Engineering Field	Teaching Experience
A-1	American	Computer	1 semester
A-2	American	Electrical	1 semester
A-3	American	Computer	4+ semesters
A-4	American	Electrical	3 semesters
C-1	Chinese	Computer	2 semesters
C-2	Chinese	Electrical	1 semester
C-3	Chinese	Computer	2 semesters
C-4	Chinese	Computer	2 semesters
C-5	Chinese	Electrical	2 semesters
C-6	Chinese	Computer	2 semesters
I-1	Indian	Computer	2 semesters
I-2	Indian	Computer	3 semesters
I-3	Indian	Computer	2 semesters
I-4	Indian	Electrical	2 semesters